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Alzheimer's Disease

Introduction

Alzheimer's disease (AD) is a progressive neurodegenerative disorder and the most common cause of dementia worldwide. It primarily affects memory, thinking abilities, behavior, and the capacity to perform daily activities. As the disease advances, neuronal death and brain tissue loss lead to significant cognitive decline and functional impairment. Alzheimer's disease is most commonly associated with aging, though it is not considered a normal part of the aging process.

Definition and Overview

Alzheimer's disease is characterized by the abnormal buildup of proteins in the brain, especially beta-amyloid plaques and tau neurofibrillary tangles. These pathological changes disrupt communication between neurons and eventually cause neuronal death. The disease typically begins slowly, with mild forgetfulness or difficulty recalling recent events, and progresses to severe memory loss and loss of independence.

Epidemiology

Alzheimer's disease affects millions of people globally. It is estimated that more than 55 million individuals worldwide live with some form of dementia, with Alzheimer's accounting for 60–70% of cases. The prevalence increases sharply with age. Women are more commonly affected than men, partly due to longer life expectancy. The societal and economic burden of Alzheimer's is significant, affecting families, healthcare systems, and caregivers.

Causes and Risk Factors

The exact cause of Alzheimer's disease is not fully understood. However, a combination of genetic, environmental, and lifestyle factors contributes to its development.

1. Age: The most significant risk factor. After age 65, the risk doubles approximately every five years.
2. Genetics: Certain genes, such as APOE-e4, increase susceptibility.
3. Family history: Having a first-degree relative with Alzheimer's raises the risk.
4. Cardiovascular factors: Hypertension, diabetes, obesity, and high cholesterol can contribute.
5. Lifestyle factors: Physical inactivity, smoking, and poor diet may increase the risk.

6. Brain injury: A history of traumatic brain injury is linked to later-life dementia.

Pathophysiology

Two major pathological features define Alzheimer's disease:

1. Beta-amyloid plaques: Clumps of protein fragments that accumulate between neurons, blocking cellular communication.
2. Neurofibrillary tangles: Twisted strands of the protein tau that disrupt nutrient transport inside neurons.

These abnormalities lead to synaptic dysfunction, inflammation, oxidative stress, and widespread neuronal death. Brain imaging often shows atrophy, especially in the hippocampus, the brain region responsible for memory formation.

Clinical Presentation

Alzheimer's disease progresses through several stages:

1. Early Stage:

- Mild forgetfulness
- Difficulty recalling recent conversations
- Trouble managing finances or planning tasks
- Personality changes

2. Middle Stage:

- Increased confusion
- Difficulty recognizing friends or family
- Problems with language and communication
- Wandering and behavioral changes

3. Late Stage:

- Severe memory loss
- Inability to perform daily activities
- Loss of mobility
- Difficulty swallowing and communicating

Diagnosis: Diagnosis involves clinical evaluation, cognitive testing, imaging, and laboratory tests. Common assessment tools include:

- Mini-Mental State Examination (MMSE)
- Montreal Cognitive Assessment (MoCA)

Brain imaging techniques such as MRI or CT can reveal structural changes, while PET scans can detect amyloid accumulation. Blood tests may help rule out other causes of cognitive impairment.

Treatment

There is currently no cure for Alzheimer's disease, but treatment focuses on symptom management and slowing progression.

1. Medications:

- Cholinesterase inhibitors (donepezil, rivastigmine)
- NMDA receptor antagonist (memantine)

These drugs improve neurotransmitter activity and may help maintain cognitive function temporarily.

2. Non-pharmacological Therapies:

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| • Cognitive stimulation | • Regular physical exercise |
| • Healthy diet (Mediterranean diet) | • Occupational therapy |

Support for caregivers is also essential, as the disease places a heavy emotional and physical burden on families.

Prevention

Although Alzheimer's cannot be fully prevented, certain lifestyle habits may reduce risk:

- Regular physical activity
- Healthy diet rich in fruits, vegetables, and omega-3 fatty acids
- Mental stimulation through reading, puzzles, or learning new skills
- Managing blood pressure, cholesterol, and diabetes
- Avoiding smoking and excessive alcohol use

Prognosis Alzheimer's disease is progressive and ultimately fatal. The average life expectancy after diagnosis ranges from 4 to 8 years, though some individuals may live 20 years or more depending on health status and early detection.

Conclusion

Alzheimer's disease remains a major global health challenge. With its rising prevalence, understanding its causes, recognizing early symptoms, and adopting preventive strategies are essential. Continued research is crucial to finding effective treatments and ultimately a cure. Early diagnosis and supportive care significantly improve the quality of life for patients and their families.

References for Alzheimer's Disease